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PATENT

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Applicants	:	Rich, et al.	)	Group Art Unit: 1756
			)	
Appl. No.	:	10/036,198	)	
			)	
Filed	:	December 28, 2001	)	
			)	
For	:	DIFFRACTIVE OPTICAL	)	
		ELEMENT AND METHOD OF	)	
		MANUFACTURE	)	
			)	
Examiner	:	Martin J. Angebrannndt	)	

DECLARATION OF PROFESSOR H. JOHN CAULFIELD UNDER 37 C.F.R. § 1.132

United States Patent and Trademark Office  
P.O. Box 2327  
Arlington, VA 22202

Dear Sir:

I, Prof. H. John Caulfield, declare as follows:

I. I am an expert in holography having authored or edited the following ten books that bear directly on holography:

- (a) H. J. Caulfield and Sun Lu, **The Applications of Holography**, John Wiley (1972);
- (b) H. J. Caulfield, ed., **Handbook of Optical Holography**, Academic Press (1979), edited by H. J. Caulfield;
- (c) H. John Caulfield & Gregory Gheen, eds. **Selected papers on Optical Computing**, SPIE Milestone Series, Vol. 1142, (1990);
- (d) Jean Robillard & H. John Caulfield, eds. **Industrial Applications of Holography**, Oxford University Press, New York (1990);

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- (d) Christopher Tocci and H. J. Caulfield, eds. **Optical Interconnection Foundations and Applications**, Artech House, Boston-London, (1994);
- (e) Mustafa A. G. Abushagur and H. John Caulfield, **Selected Papers on Fourier Optics**, SPIE Milestone Series, Vol. Ms. 105, 610 pps., 61 papers, (1995);
- (f) Hans Bjelkhagen and H. John Caulfield, **Selected Papers on Holography**, SPIE Milestones Series, (2001);
- (e) H. John Caulfield, Jacques Ludman, and J. Riccobono, eds **Holography for the New Millennium**, Springer Verlag, (2002);
- (f) H. John Caulfield, ed. **Optical Information Processing: A Tribute to Adolf Lohmann**, SPIE Press. H. John Caulfield, ed (2002);
- (g) H. John Caulfield, ed. **The Art and Science of Holography: A Tribute to Emmett Leith and Yuri Denisyuk**, SPIE Press, Bellingham, WA (2004).

2. In addition, I have authored the following twenty-four (24) book chapters are that bear directly on holography:

- (a) H. J. Caulfield, "Holography by Shadow Casting," in **Progress in Electro-Optics**, E. Camatini, Ed., Plenum Press, NY (1975);
- (b) H. J. Caulfield, "Holographic Spectroscopy," in **Advances in Holography**, Vol. 2, N. H. Farhat, Ed., Dekker, NY (1976);
- (c) H. J. Caulfield, "The Applications of Coherent Optical Image Processing in Medicine and Biology," in **Holography in Medicine**, IPC Science and Technology Press, Surrey, England (1976);
- (d) H. J. Caulfield, "Holography and Optical Data Processing," **Encyclopedia of Computer Design and Technology**, Vol. 9, J. Belzer, A. G. Holzman, and A. Kent, Eds., M. Dekker, NY, 283 (1978);
- (e) D. Casasent and H. J. Caulfield, "Basic Concepts," in **Optical Data Processing**, D. Casasent, Ed., Springer-Verlag, NY (1978);
- (f) H.J. Caulfield, "Biomedical Applications of Coherent Optics," in **Optical Data Processing**, D. Casasent, Ed., Springer-Verlag, NY (1978);

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- (g) H.J. Caulfield, "Holography and Coherent Optics for Industrial Metrology," **SME Technical Paper**, No. 1080-929 (1980);
- (h) H. J. Caulfield, R. H. Jackson, and R. P. Brailley, **Holography Works, Museum of Holography**, NY (1983);
- (i) Mir Mojtaba Mirsalehi, Mustafa A. G. Abushagur and H. John Caulfield, "Optical and Opto-electronic Computing," **Advances in computers**, Vol. 28, pp. 153-226, Academic Press, Boston (1989) Editor: Marshall C. Yovits;
- (j) Mustafa A. G. Abushagur and H. J. Caulfield, "Optical Matrix Computations," **Optical Processing and Computing**, pp. 223-249, Academic Press, Boston (1989) Edited by Henri H. Arsenault, Tomasz Szoplik & Bohdan Macukow;
- (k) H. J. Caulfield, "The Holographic Basis for Intelligent Machines," in **Industrial Applications of Holography**, Chapter 1, pgs 3 - 8, Oxford University Press, New York (1990);
- (l) H. J. Caulfield, "Holography and Information: Getting Something for Nothing with Light," in **Homageto Galileo**, pp. 37-52, Cooperative Libreria Editrice dell'Universita' de Padova, Padova (1992), P. Mazzoldi., ed., Galileo's "Occhialino" to Optoelectonics, River Edge, NJ, Paolo Mazzoldi, Ed., World Scientific Publishing Co. Pte. Ltd.;
- (m) H. I. Jeon, J. Shamir, B. Johnson, H. J. Caulfield, J. Kinser, C. Hester and M. Temmen., "The Use of Fixed Holograms for Massively-Interconnected, Low Power Neural Nets," in **Neural Networks for Perception**, H. Wechsler, Ed., V.II, pp. 282-309, Academic Press (1992);
- (n) H. John Caulfield, Joseph Shamir, "Fixed Hologram Neural Networks," **Real-Time Optical Information Processing**, Chapter 7, pp.255-305, Academic Press, Inc., (1994);
- (o) J.L. Johnson, H. Ranganath, G. Kuntimad, H. J. Caulfield, "Pulse-Coupled Neural Networks," Neural Networks and Pattern Recognition, Omid Omidvar, and Judith Dayhoff, Eds. (Academic Press, 1998), Chapter 1, pp. 1-56;
- (p) H. John Caulfield, Jacques Ludman, and Joseph Shamir, "Fuzzy Metrology," **Fuzzy Systems Theory**, Vol.2. (Academic Press, NY, 1999), Chapt. 26, pp. 747-758;

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- (q) H. J. Caulfield and J. Shamir, "Holograms of Real and Virtual Point Trajectories," in **Three-dimensional Holographic imaging**, C. J. Kuo and M. H. Tsai eds, Wiley-Interscience, NY (2002), pp. 5-20;
- (r) I. Ternovskiy, T. Jansson, and H. J. Caulfield, "Is Catastrophe Analysis the Basis for Visual Perception?," in **Three-dimensional Holographic imaging**, C. J. Kuo and M. H. Tsai eds, Wiley-Interscience, NY (2002), pp. 5-20;
- (s) P. Hemmer, S. Shariar, J. Ludman, and H. J. Caulfield, "Holographic Optical Memories," Chapt. 8 in **Holography for the New Millennium**, Springer Verlag, NY (2002), J. Ludman, H. J. Caulfield, and J. Riccobono, eds., pp. 179-190;
- (t) H. John Caulfield, Don O Henderson and Mikhail A Noginov, "Randomness in complex materials," Chapt. 22 in Werner S. Weiglhofer, and Akhlesh Lakhtakia, eds. **Introduction to Complex Mediums for Optics and Electromagnetic**, SPIE Press, Bellingham, WA (2003) pp. 549-590;
- (u) Q. Huang and H. J. Caulfield, "Waveguide holography and its applications," in Stephen A. Benton, **Practical Holography**, SPIE Press, Bellingham, WA (2003);
- (v) Q. Huang, J. A. Gilbert, and H. J. Caulfield, "Substrate guided-wave holography," in Stephen A. Benton, **Practical Holography**, SPIE Press, Bellingham, WA (2003);
- (w) J. E. Ludman, J. R. Riccobono, H. J. Caulfield, J.-M. R. Fournier, I. V. Semenova, N. O. Reinhard, P. R. Hemmer, and S. M. Shahriar, "Porous-matrix holography for nonspatial filtering of lasers," in Stephen A. Benton, **Practical Holography**, SPIE Press, Bellingham, WA (2003); and
- (x) H. John Caulfield, "Chapter 21. The Bizarre World of the Holographic Brain" in H. John Caulfield, ed. **The Art and Science of Holography: A Tribute to Emmett Leith and Yuri Denisyuk**, SPIE Press, Bellingham, WA (2004);

2. Additionally, I am named as author on two hundred and twenty-one (221) refereed journal papers about one-half of which are on holography.

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3. I am named as an inventor on the following fifteen U.S. Patents related to holography:
- (a) U.S. Patent 3,433,139 entitled "Electro-Optic Controls For Reflex Cameras" issued in 1969 to H. J. Caulfield;
  - (b) U.S. Patent 3,540,791 entitled "Simplified Multiple Image Generation" issued 1970 to H. J. Caulfield and S. Lu;
  - (c) U.S. Patent 3,627,400 entitled "Addressing Holographic Apparatus For Use With Space Division Multiplexed Holograms" issued 1971 to H. J. Caulfield;
  - (d) U.S. Patent 4,498,740 entitled "Hologram Writer and Method" issued 1985 to H. J. Caulfield;
  - (e) U.S. Patent 4,510,575 entitled "Method of Writing Holograms" issued 1985 to P. F. Mueller and H. J. Caulfield;
  - (f) U.S. Patent 4,655,539 entitled "Hologram Writing Apparatus and Method" issued 1987 to H. J. Caulfield and M. Camac;
  - (g) U.S. Patent 5,295,208 entitled "Multimode Waveguide Holograms Capable of Using Non-coherent Light" issued 1991 to H. John Caulfield et al;
  - (h) U.S. Patent 5,132,813 entitled "Neural Processor with Holographic Optical Paths and Nonlinear Operating Means" issued 1992 to H. John Caulfield et al;
  - (i) U.S. Patent 5,056,039 entitled "Holographic interconnect System" issued 1991 to H. John Caulfield et al;
  - (j) U.S. Patent 5,515,184 entitled "Waveguide Hologram Illuminators" issued 1998 to H. John Caulfield et al;
  - (k) U.S. Patent 5,854,697 entitled "Waveguide Hologram Illuminators" issued 1998 to H. John Caulfield et al;
  - (l) U.S. Patent 6,385,474 entitled "Method and Apparatus for High Resolution Detection and Characterization of Medical Pathologies" issued 2002 to J. D. G. Rather et al;
  - (m) U.S. Patent 6,540,678 entitled "Real Time Three Dimensional Acoustoelectronic Imaging and Characterization of Objects" issued 2003 to J. D. G. Rather et al;

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- (n) U.S. Patent 6,639,733 entitled "High Efficiency Non-imaging Optics" issued 2003 to Juan C. Minano et al; and
- (o) U.S. Patent 6,728,567 entitled "Method and Apparatus for High-resolution Detection and Characterization of Medical Pathologies" issued 2004 to J. D. G. Rather et al;

4. I have written many popular articles in the field of holography including the most widely read article any scientist has ever written – the 1984 National Geographic cover story "The Wonder of Holography" that was read by more than 25,000,000 people.

5. My work in the field of holography has been noted in Scientific American, IEEE Spectrum, American Way, and Delta Sky.

6. I have written chapters on holography for Marcel Dekker's **Encyclopedia of Modern Optics**.

7. I have authored the first paper in the first issue of a new journal, **Holography and Speckle**.

8. I chaired the first Gordon Research Conference on holography and have chaired holography conferences for OSA, SPIE, and IEEE.

9. I am on the editorial boards of the only two holography journals **Holography and Speckle** and **Holography News**.

10. In 1994, I won the Dennis Gabor Award Honoring the Nobel Prize winning inventor of holography, which is given for major contributions to the field.

11. I am the winner of the 2005 Gold Medal presented by SPIE, the International Society for Optical Engineering, for contributions to holography, imaging, optical computing, optical logic, and inventions including local reference beam holography, coherence gated imaging,

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generalized matched filters, optical linear algebra, fuzzy optical metrology, artificial color, and passive conservative interferometric logic gates. Previous winners include Nobelists and famous optics inventors such as Ed Land and Doc Edgerton.

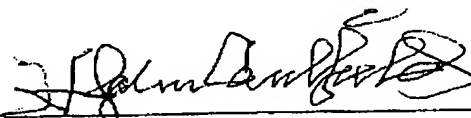
12. I have reviewed U.S. Patent 4,657,780 (Pettigrew et al), U.S. Patent 5,198,912 (Ingwall et al), and International Publication WO 01/90822 (Sutherland et al), and I am familiar with these documents.

16. In my opinion, I would not be motivated to combine the teachings regarding liquid crystal in Ingwall et al and Sutherland et al with the teachings regarding manufacturing diffraction gratings in Pettigrew et al. Pettigrew et al shows a diffraction grating formed by bringing a grating-bearing surface coated with a release agent together with a rigid substrate having a layer of UV sensitive liquid resin applied thereto to form a profiled, cured resin film. In contrast, Ingwall et al and Sutherland et al teach liquid crystal in the context of volume holograms that are switchable. The diffraction gratings taught by Pettigrew et al are different from volume holograms. Likewise, I would not be motivated to combine teachings relevant to the materials used in volume holograms with teachings regarding forming a diffraction grating as taught by Pettigrew et al. Similarly, with knowledge of the combined teachings of Pettigrew et al, Ingwall et al, and Sutherland et al, it would not be obvious to use optical liquids such as liquid crystal in forming the diffraction gratings taught by Pettigrew et al.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or patent issuing therefrom.

Dated: 9 March 2005

By:



Prof. H. John Caulfield

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